LB-30/LIBERATOR II

DETAIL SPECIFICATIONS

19 JULY, 1940 through 12 APRIL, 1941 revisions

From the collection of Alan Griffith

CONFIDENTIAL REPORT

NO. ZD-32-006

DETAIL SPECIFICATION

FOR

THE MODEL LB-30 LIBERATOR II AIRPLANE

(FOUR-ENGINE BOMBARDMENT)

19 JULY 1940

(A) REVISED: 12 SEPTEMBER 1940

(B) REVISED: 18 OCTOBER 1940

Revision (B) included discussions of Mockup Conference of 17 October 1940.

(C) REVISED: 10 FEBRUARY 1941

(D) REVISED: 12 APRIL 1941

APPROVED: _____ 4-28-41

F. A. Firth, Resident Technical Officer
British Purchasing Commission

BY

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INTRODUCTION

This specification covers the one hundred and thirty-nine (139) LB-30 Liberator II airplanes ordered by His Majesty's Government in the United Kingdom from the Consolidated Aircraft Corporation under Contract F-677 and Contract Amendments 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14 and 15. Contract Amendments 13 and 16, while applicable to the subject contract, only affect the twenty (20) LB-30B Liberator I airplanes.

Revision D, dated 12 April 1941, incorporated all applicable contract amendments in effect on the foregoing date, as well as changes authorized by the Technical Branch of the British Air Commission for which contract negotiations are now being completed.

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CONSOLIDATED AIRCRAFT CORPORATION
SAN DIEGO, CALIFORNIA

MODEL LB-30 AIRPLANE REPORT NO ZD-32-006

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PART I

A - GENERAL DESCRIPTION

1. This Specification lists the requirements of the LB-30 Liberator II airplane being built under British Purchasing Commission Contract No. F-677. Model 32 shall designate the Consolidated model number for this airplane. The structure and controls of this airplane shall be identical to current models being furnished the United States Government except as mentioned herein, or as required to install equipment listed herein.

2. The airplane shall be a four-engine monoplane, capable of taking off under its own power, alighting and taxiing on prepared runway surfaces, or grass covered airdromes, using its tri-wheel type undercarriage.

3. The exterior arrangements of this airplane shall be in accordance with Appendix I.

(B) 4. The arrangement of the fuselage from nose to tail shall include the following compartments:

(a) A compartment for the front gunner-bomb aimer, with bombsight provisions, and a .303 calibre flexible machine gun carried in ball and socket type mount.

(b) An operating compartment with seats and controls for a first and second pilot in the forward section, an aft section for the W/T operator's station, and a navigator's station.

(c) A fore and aft bomb compartment.

(d) A rear gunner's compartment with provisions for a power-operated top turret, a waist gun station on each fuselage side, an under defense gun station, and a tail turret.

5. The principal material used in the structure shall be heat-treated aluminum alloy. All sheet aluminum alloy, and sections drawn from sheet, shall be of the "Alclad" type. Riveting shall be the principal means of assembly with flush riveting used on the critical wing and tail surface areas.

6. The airplane shall be powered with four Pratt & Whitney Model R-1830-S3C4-G two-speed supercharger engines. Their ratings are listed in Paragraph 14.

7.
dix III. Insignia and camouflage shall be in accordance with Drawing 3225011.

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B - WEIGHT & PERFORMANCE

10. The WEIGHT EMPTY is estimated to be as follows:

Wing		6,812
Tail		744
Fuselage		4,363
Nacelles		1,090
Alighting Gear		2,867
Power Plant		11,025
Fixed Equipment		5,413
Instruments	176	
Surface Controls	639	
Electrical	805	
Furnishings	3280	
Communicating	513	
TOTAL WEIGHT EMPTY		32,314 Lbs.

11. The NORMAL USEFUL LOAD for performance estimating purposes has been assumed as follows:

Crew and parachutes (7 @ 200#)	1,400
1 Front Gunner and bomb aimer	
1 Navigator	
1 First Pilot	
1 Second Pilot	
1 W/T Operator	
1 Upper Mid-Turret Gunner	
1 Tail Gunner	
Fuel (756 Imp. Gallons)	5,488
Oil (47 Imp. Gallons)	423
Machine Guns, accessories and ammunition	1,415
Bombs	0
TOTAL NORMAL USEFUL LOAD	8,686 Lbs.

(D) 12. The ALTERNATE USEFUL LOAD for performance estimating purposes has been assumed as follows:

Crew and parachutes (7 @ 200#)	1,400
Fuel (1885 Imp. Gallons)	13,572
Oil (118 Imp. Gallons)	1,062
Machine Guns, accessories and ammunition	1,415
Bombs and Shackles	6,237
TOTAL ALTERNATE USEFUL LOAD	23,686 Lbs.

13. The DESIGN GROSS WEIGHT HAS BEEN ASSUMED AS . . 41,000 Lbs.

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14. The Pratt & Whitney R-1830-S3C4-G Geared 16:9 engine ratings are as follows:

Normal	1100 BHP @ 2550 RPM @	6200 ft.
	1100 BHP @ 2700 RPM @	14500 ft.
Military	1200 BHP @ 2700 RPM @	4900 ft.
	1050 BHP @ 2700 RPM @	13100 ft.
Take-Off	1200 BHP @ 2700 RPM @	Sea Level

15. The following estimated performance data are based on the above power ratings and on flight with all doors and hatches closed, with all guns and turrets in the retracted position, with ice elimination equipment installed but inoperative, and with no radio antennas or loops installed. All tests and demonstrations shall be conducted in accordance with the Contractor's standard practice. Items marked with an asterisk are guaranteed within 3%.

	Normal	Alternate
(D) Gross Weight (See paragraphs 11 & 12 Bomb Load Fuel Load	41,000 lbs. (0 lbs.) (756 Imp.Gal.)	56,000 lbs. (6237 lbs.) (1885 Imp.Gal.)
High Speed at the Altitude at which maximum level flight speed is attained with Military Rated Power of 1050 BHP/Engine.	*278 MPH	
Estimated Altitude for maximum level flight speed with Military Power	15,100 ft.	
High Speed with Normal Rated Power	276 MPH @16,500 ft.	
Operating Speed with 75% Normal Rated Power	245 MPH @14,500 ft.	
Range at an Operating Speed of 245 MPH @ 14,500' with 756 Imp. gallons fuel	Statute Miles	
(D) Maximum Range	*1,420 Statute Miles with 756 Imp. gallons	*3,020 Statute Miles with 1885 Imp. gallons.
Average Airspeed for Maximum Range	167 MPH @14,500 ft.	184 MPH @14,500 ft.
Rate of Climb at Sea Level	1,870'/Min.	
Service Ceiling	*24,300 ft.	
Service Ceiling on Any Two Engines	*9,500 ft.	
Take-Off Distance on Hard Surface Runway to Clear a 25' Obstacle	*2,200 ft.	4,000 ft.
Landing Distance on Hard Surface Runway to Clear a 25' Obstacle	*1,750 ft.	

Additional range data showing the effect of substituting bombs for fuel are shown on the range-bomb load chart, page 4.

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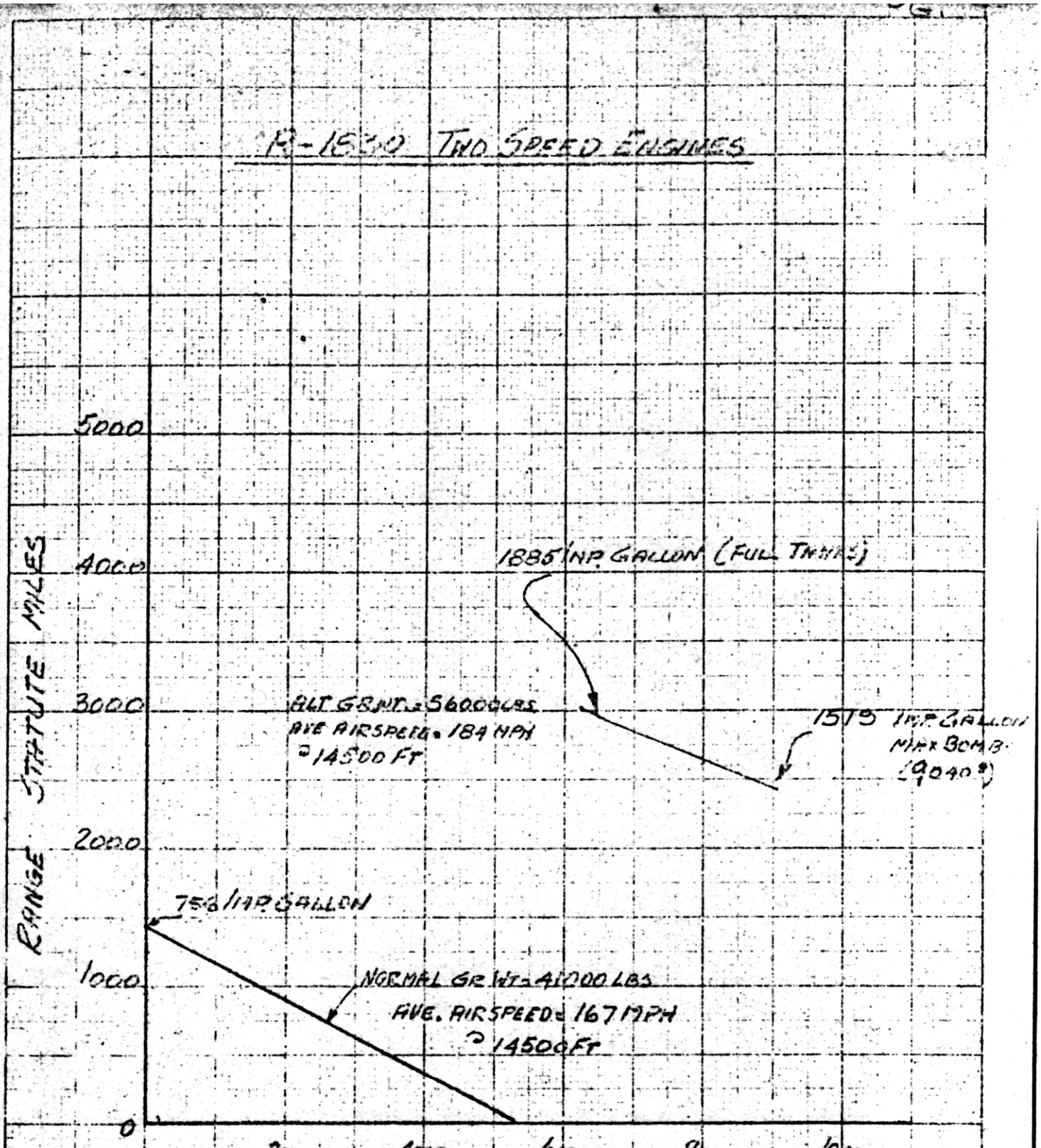
R-1830 TWO SPEED ENGINES



NOTE: RANGE BASED ON DROPPING BOMBS AT HALF WAY

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C - ENGINEERING DATA

20. The following general dimensions are furnished for reference only. More complete dimensioning will be found on the three-view drawing, Appendix I.

Length overall	66' 0"
Height (Maximum on landing gear)	17' 11"
Span	110' 0"
Mean Aerodynamic Chord	123.7
Aspect Ratio	11.55
Taper Ratio (in plan)	.372
Width of Fuselage	7' 5"
Height of Fuselage	10' 5"
Tread of Main Wheels	25' 7"

21. Areas are approximately as follows:

Total wing including ailerons	1048 sq.ft.
Ailerons, aft of hinge	63.2
Stabilizer to elevator hinge	140.5
Elevators aft of hinge	51.5
Fins to rudder hinge	139.
Rudders aft of hinge	48.9

22. The following minimum loading conditions shall be met by the airplane structure without exceeding the yield strength of the materials:

Gross Weight	41,000#	56,000#
Positive maneuvering load factor	3.67	2.67
Negative maneuvering load factor	2.00	1.40
Indicated diving speed with a 30 f.p.s. gust expressed in per cent of the maximum indicated level flight speed	125%	100%
Landing Limit Load Factor	3.00	2.50

(a) The ultimate strength shall be at least 150% of the yield strength.

(b) A curve sheet showing allowable load factors and diving speeds based on the calculated strength of the airplane plotted against gross weight is included as page 6.

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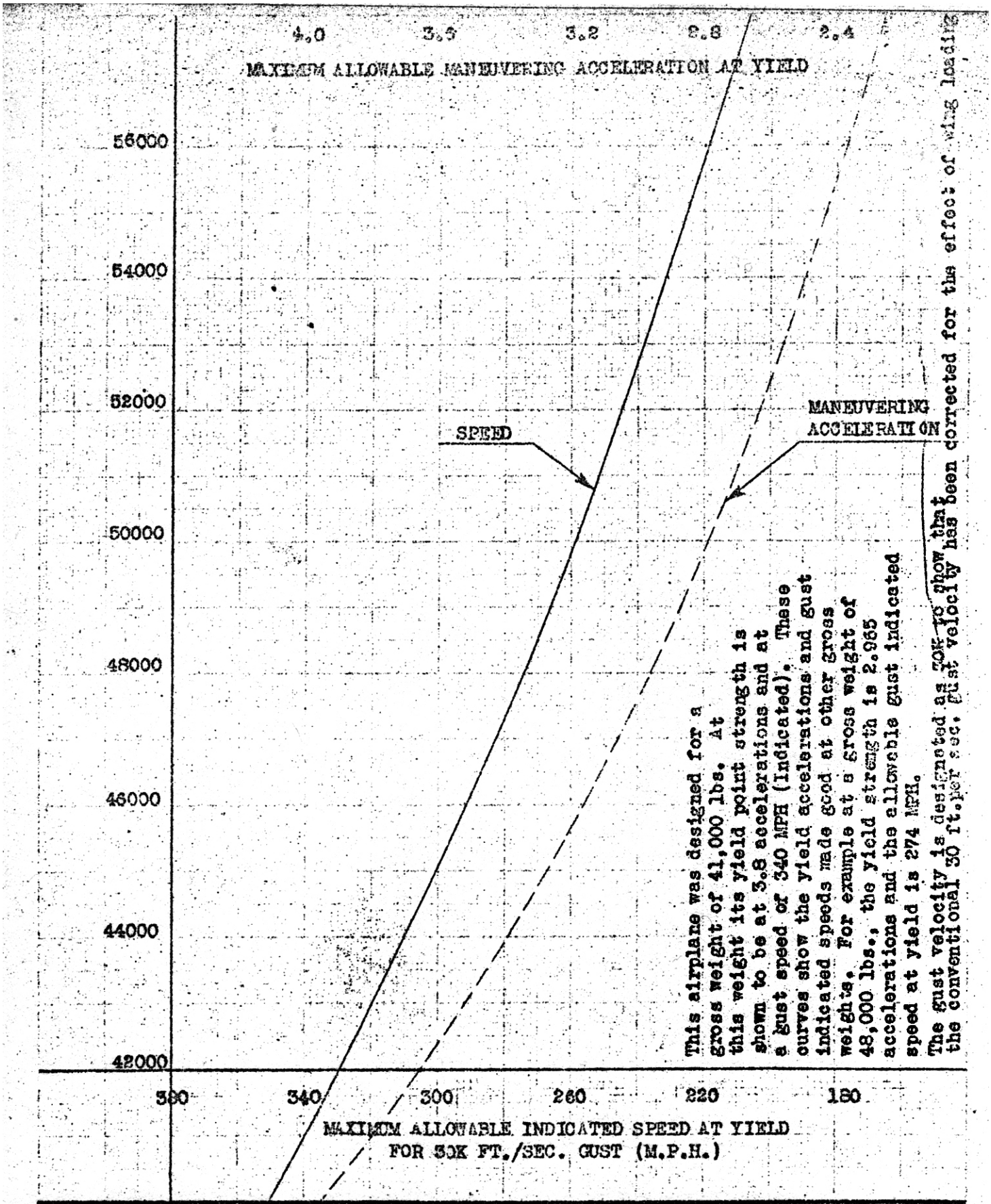

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D - BALANCE & FLYING CHARACTERISTICS

30. The disposition of the crew and load, for balance and stability purposes, shall be such as to place the gross weight center of gravity no further aft than 35% M.A.C. This allows the maximum bomb load of 8800 pounds to be carried.

31. It shall be possible to balance and control the airplane under the specified load conditions with, and without power, and at all speeds above the stall.

32. The airplane shall have positive longitudinal stability in level flight from 120% stalling speed to maximum level speed.

33. The airplane shall have positive directional stability in the air, with and without power, with free or locked controls, and under the specified load conditions.

34. The airplane shall have positive lateral stability in the air, with and without power, with free or locked controls, and under the specified load conditions.

PART II

A - WING GROUP

50. The wing shall consist of a center panel and two outer panels with removable tips. The structure shall be of aluminum alloy beams, bulkheads, and stressed skin construction. There shall be two beams or spars.

51. The wing structure shall be attached to the fuselage by rivets.

(D) 52. Space shall be provided between the spars on each side of the centerline for the installation of the fuel cells described in Paragraph 108. An access door shall be provided in the lower surface of the wing on each side of the centerline to allow installation and removal of the fuel cells. The panels shall be fastened with screws into self-locking nuts. This space shall be fuel tight.

53. The leading edge sections between nacelles, and between the fuselage and the nacelles, shall be removable for access to the engine controls and piping.

54. Cable mooring loops shall be provided in the wing for staking the airplane.

55. Two ailerons of metal structure with fabric covering shall be provided. The leading edge of the ailerons shall extend forward of the hinge line to provide a partial aerodynamic balance and a complete static balance. A trim tab with an irreversible control shall be installed in the trailing edge of one aileron.

56. Extensible, trailing edge flaps shall be provided between the fuselage and the inboard ends of the ailerons. These flaps shall be of metal structure with metal covering and shall be attached to the wing structure by rollers working in tracks.

B - TAIL GROUP

60. The tail group shall consist of a fixed horizontal stabilizer supporting a fin and rudder at each end, and elevators on its trailing edge. The stabilizer and fins shall be of all-metal construction. The rudders and elevators shall have metal structures and be fabric covered.

61. The leading edges of the rudders, and the elevators, shall extend forward of the hinge lines to provide partial aerodynamic balance and complete static balance about the hinge lines.

62. Trim tabs, controllable from the pilots' compartment shall be installed in the rudder and elevator trailing edges. Irreversible mechanism shall be incorporated in the tab controls at the surfaces.

C - BODY GROUP

70. The fuselage shall be constructed of smooth metal skin riveted to longitudinal stringers and transverse bulkheads.

71. Transparent window material shall be installed to allow vision in the following directions:

For the Front Gunner and Bomb Aimer - The forward hemisphere
For the First and Second Pilots - The forward upper quarter and areas back over the top, over side rear, and over side downward.
For the Waist Gunner - All firing angles.
For the Under Defense Gunner - All downward firing angles.

Additional windows shall be provided for illumination. All transparent panels shall be of plastic material, except the bomb sight window, which may be laminated plate glass.

71a. A small side section, on each side of the pilots' main windshield, shall be openable to permit direct forward vision should normal vision be hampered by abnormal icing conditions. A thumbscrew device shall be incorporated to break the initial ice lock and thereby facilitate opening the small windshield side openings.

71b. A Customer furnished navigator's sighting dome shall be located on the top center of the fuselage aft of the pilots' enclosure. An elbow rest shall be provided.

71c. A streamlined dome shall be mounted in each of the pilots' enclosure sliding windows.

72. Fuselage doors shall consist of:

1. A nose wheel well with hinged doors.
2. Two bomb bays with sliding doors.
3. A main rear bottom entrance door, in the aft end of the gunner's compartment. An entrance ladder shall be provided. This ladder, when in position, shall also serve to hold up the tail when the airplane is parked.
4. Two waist gun doors.
5. A pilots' ceiling escape hatch.

All of the above doors shall be fitted with controls to make them suitable as emergency exits. In addition, all but the nose wheel doors shall be provided with facilities for opening from the exterior.

73. Passageways shall be provided for entrance to all compartments.

74. Tying down provisions shall be provided for use when the airplane is parked [illegible].

75. A rear bottom entrance door shall incorporate the under defense gun ball and socket mount.

D - NACELLES

80. Each engine nacelle structure built out from the wing, shall consist of an engine mount, an oil tank, cowling, supports, and fairing.

81. The engine mount shall be a welded steel tube structure to which the engine shall be attached by dynamic pedestal mounts. The design shall be such that the engine and mount may be removed as a unit.

82. The oil tank shall be designed as a structural member, carrying the engine load into the wing structure. It shall be attached to the wing with bolts and screws to facilitate removal. The front face of each tank shall be of corrosion resistant steel, and shall serve as part of the firewall.

83. An engine ring cowl with removable access panels shall enclose each engine, and together with the engine baffles, control the flow of engine cooling air. Controllable cowl flaps shall be incorporated in the ring cowl trailing edge.

84. The accessory section shall be shielded from hot engine air by a diaphragm and an exhaust collector shroud.

85. Panels of corrosion resistant steel shall fill the area between the oil tank and the cowl to complete the firewall separating the engine section from the rear section of the nacelle.

86. Removable cowl shall fair the sides of the oil tanks into the nacelles and cover controls and lines.

87. The nacelle structure aft of the tanks shall be integral with the wing.

E - ALIGHTING GEAR

90. The alighting gear shall be of the tricycle type. The main wheel gear will be mounted under the wing aft of the center of gravity, and the nose wheel gear will be mounted in the forward section of the fuselage.

91. The main wheels shall retract into the lower surface of the wing. The nose wheel shall retract into the nose wheel well in the fuselage.

92. The retracting mechanism shall be operated by hydraulic actuating cylinders controlled by the landing gear actuating lever on the pilots' pedestal. Latches shall be installed for holding the gear in the extended and retracted positions. A manually operated mechanism, independent of the hydraulic system, shall be provided for emergency extension of the alighting gear.

92a. An inter-locking safety system to prevent landing gear retraction when the gear is extended, and supporting the weight of the airplane, will be provided.

93. The two main wheels shall be of the smooth contour type and 56 inches in diameter. Each wheel shall be mounted on an oleo pneumatic shock absorbing strut having a 13 inch stroke.

94. The nose wheel shall be of the smooth contour type, and 36 inches in diameter. It shall be mounted on an oleo pneumatic shock absorbing strut having a 14 inch stroke. The nose wheel assembly shall incorporate a shimmy damper to prevent unstable oscillation of the wheel, but shall allow it free swiveling 45 degrees either side of neutral for ground maneuvering. A device shall be installed to automatically align the wheel with the plane of symmetry when the gear is extended and not under load. In addition to the foregoing, the nose wheel shall be provided with a mudguard. A canvas splash shield shall be installed to protect the control sprockets and chains.

95. Hydraulic power brakes, individually controlled by auxiliary pedals on the rudder pedals, shall be installed on the main wheels. A parking brake lever, on the pilots' pedestal, shall be provided to lock the brake controls when the airplane is parked.

96. A safety wheel shall be installed in the under rear of the fuselage as a third contact point if the tail is lowered.

97. Lugs shall be provided on the main struts for towing the airplane either forward or backward. Attachment shall be provided on the nose wheel gear for a towing and steering bar (See Paragraph 250).

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F - POWER PLANT

100. A power plant installation shall include four engines, each mounted in a nacelle attached to the wing leading edge. Engine ratings are listed in Paragraph 14.

101. A Customer furnished Curtiss electrically controlled propeller, without fast feathering features or an automatic synchronizer, but which shall have full feathering and electrically controllable governor with a control switch on the pilots' pedestal, shall be installed on each engine. Refer to Appendix V for additional details.

102. A combined hand-electric inertia starter with solenoid meshing device, as listed in Appendix V, shall be installed on each engine. A solenoid starter switch shall be provided for each starter. A means of priming, and a booster coil, shall be provided for each engine to facilitate starting. Only one hand starter crank and extension shall be included in the weight empty.

D) 103. The engine air intake shall be of the ramming type, taking air from in front of the engine. A valve shall allow an alternative supply of warm air from behind the cylinders.

104. Each engine shall be provided with a complete exhaust manifold which exhausts from the outboard side of the nacelle below the wing.

A) 105. The cooling system shall consist of the engine cowling with its electrically controlled cowl flaps, and the baffles furnished by the engine manufacturer. The engine cooling provisions shall correspond with those for U.S. Army airplanes of this type.

B) 106. The Power Plant controls shall be located as follows:

On the control pedestal between pilots:

4 Individual engine throttles
4 Individual engine supercharger controls
4 Individual propeller governor setting switches
4 Individual carburetor mixture controls

Convenient to the second pilot:

A) 1 Carburetor air preheat valve control
4 Engine cowl flap controls
4 Engine starter energizing and meshing switches
2 Dual primer switches
4 Booster fuel pump switches
2 Dual ignition switches
C) 4 Propeller master cut-out switches

(a) Engine throttle control handles shall be moved forward to open the throttles and shall be so arranged that they may be operated individually or collectively.

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A) (b) Carburetor mixture controls shall be moved aft to increase the richness. A stop shall be provided to prevent accidental movement of these controls into the idle cut-off position.

(c) Engine supercharger controls shall be moved forward for high blower.

107. An independent oil system shall be provided for each engine. Each system shall include an oil tank of 56 Imp.gallons capacity, exclusive of foaming space, and a regulating system for maintaining oil at proper operating temperatures. The oil tanks (see Paragraph 82) shall have a hopper installed so that the oil in circulation will be a small proportion of the total in the tank. An oil cooler shall be installed for each engine with an automatic by-pass valve to act as a temperature regulator and congealing protection device. A drain valve shall be provided in each oil system. An oil dilution system shall be provided to facilitate engine starting in cold weather.

)) 107a. Oil cooler shutters shall be installed at the cooler duct outlets with actuating controls in the fuselage flight deck near the navigator.

108. The fuel system shall consist of fuel containers, piping, pumps, strainers, quantity gages, and fittings.

)) (a) The fuel tight space (see Paragraph 52) shall be fitted with twelve self-sealing fuel cells, the wing bulkheads forming the divisions. The fuel cells shall be so connected that a set of three cells of approximately 470 Imp.gallons capacity will be connected to each engine. The total capacity of all cells shall be approximately 1885 Imp.gallons.

(b) Each engine shall have an independent fuel system which, in addition to the fuel cells, shall consist of an engine-driven pump, a strainer and sediment trap installed in the nacelle, an electric-driven booster pump installed below the wing to maintain inlet pressure on the engine-driven pump, and connecting lines.

(c) In most cases, fuel carrying lines shall be of self-sealing hose. Vent lines shall be of aluminum alloy tubing, except that between cells bellows type neoprene tubing shall be used.

) (d) Two fuel quantity gages of the boiler type shall be provided. The gages shall give correct fuel quantity readings when the inclinometer shows the fuselage to be level. Valves shall be provided to connect the cells for which a reading is desired, and to prevent leakage in the event of a broken gage tube.

(e) To transfer fuel from one set of cells to either of the three other sets, a power operated pump shall be provided. The pump, located above the rear spar, will effect fuel transfer when it is connected to lines leading to the cells between which transfer is desired. The pump shall be connected to these lines by means of a quick disconnect [illegible]

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G - FIXED EQUIPMENT

INSTRUMENTS

B) 110. The following instruments shall be installed on the pilots'
D) instrument panel:

	1	Airspeed Indicator
	1	Altimeter
	1	Automatic Pilot
	1	Blind Approach Indicator
*	1	Directional Gyro
	2	Engine Temperature Indicators (dual)
	2	Fuel Pressure Indicators (dual)
*	1	Gyro Horizon (Uncaged type)
	4	Hydraulic Pressure Gages
	1	Landing Gear and Wing Flap Position Indicator
	2	Manifold Pressure Indicators (dual)
	2	Oil Temperature Indicators (dual)
	2	Oil Pressure Indicators (dual)
	1	Radio Compass Indicator
	1	Rate of Climb Indicator
	2	Tachometer Indicators (dual)
	1	Thermometer, Free Air
	1	Turn & Bank Indicator

* In addition to those in automatic pilot

3) (a) Engine instruments shall be grouped convenient to the second pilot.

)) (b) An aperiodic compass, Pioneer 1809, shall be mounted on Lord type shock mounts on the left of the compartment.

(c) A clock, mounted so as to be visible to both pilots, shall be located on the left side of their compartment.

1) 111. The following instruments shall be installed convenient to the navigator:

1	Airspeed Indicator
1	Altimeter
1	Aperiodic Compass, 0-2
1	Clock (Elapsed time type)

3) 112. The following instruments shall be installed convenient to the front gunner-bomb aimer.

1	Airspeed Indicator
1	Altimeter.

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H - FLIGHT CONTROL SYSTEM

120. Dual flight controls shall be provided for the first pilot and second pilot. The aileron and elevator controls shall be of the wheel type. The rudder controls shall be of the sliding pedal type.

121. Aileron, elevator, and rudder trim tab controls shall be located on the pedestal convenient to both pilots. The tab control wheels shall move in the same sense as the aircraft movement. Indicators shall be provided to show the displacement of the trim tabs relative to their supporting surfaces.

122. An automatic pilot shall be installed in the center of the instrument panel. For vacuum sources, see Paragraph 150. For hydraulic power source, see Paragraph 145. The servo units, actuated by the automatic pilot, shall be connected to the control system.

122a. In order to adapt the Sperry A-3 gyropilot for use with the Sperry O-1 Bomb Sight it shall be necessary for the Contractor to modify the following parts of the A-3 gyropilot in accordance with Amendment No. 11 to subject contract:

(a) Directional Gyro Control.
(b) Mounting Unit.
(c) Navigator's Turn Control
(d) Selector Switch
(e) Mounting Unit Adapter.

123. The wing flaps shall be interconnected and operated by a single hydraulic actuating cylinder with its control valve handle on the control pedestal. An emergency means of lowering the flaps shall be provided.

124. A control surface lock shall be provided to hold the ailerons, rudders, and elevators in neutral while the airplane is parked. The lock shall be operable from the pilots' compartment by moving the controls to the neutral position and setting the lock. The lock handle, located on the pilots' pedestal, shall be held in the locked position by a safety device to prevent take-off with the controls so held.

I - ELECTRICAL SYSTEM

130. The 24-volt electrical system utilizes four Customer furnished engine-driven generators, and two 24-volt, 36 ampere hour batteries. Electricity shall be utilized to operate the starters, lights, radio, propeller controls, electrical instruments, bomb release mechanism, and auxiliary hydraulic pumps. Single conductor ground return type wiring shall be used except where double wires are installed between the generator and voltage regulators.

131. A Customer furnished voltage regulator shall be provided in the fuselage for each generator.

132. A battery disconnect switch shall be installed adjacent to each battery with remote control switches at the right of the pilots' instrument panel.

132a. The following switches are to be located to the right of the instrument panel:

(a) 2 Battery Disconnect Remote Control Switches
(b) 4 Booster Fuel Pump Switches
(c) 1 Carburetor Pre-Heat Control Switch
(d) 4 Cowl Flap Control Switches
(e) 2 Dual Ignition Switches
(f) 2 Dual Primer Switches
(g) 1 Oil Dilution Switch
(h) 4 Starter Switches

132b. The following switches are to be located to the left of the instrument panel:

(a) Formation Light Switch
(b) Headlight Switch
(c) Intercall Light Switch
(d) Instrument Light Switches
(e) Landing Gear Warning Switch
(f) Landing Light Switches
(g) Running Light Switches

(B)132c. Propeller feathering control switches shall be located above the instrument panel at its center. A propeller switch guard shall be installed to prevent accidental switch movement.

(B)133. One, Customer furnished, recessed plug-in socket for connecting with ground batteries shall be installed in the bottom of one nacelle to provide outside power for starting the engines.

133a. Installation provisions for a Customer furnished Aldis lamp shall be made in the pilots' compartment; stowage for this lamp shall also be provided.

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(B) 134. The following exterior lights shall be installed:

1. Navigation Lights - on each wing tip and tail.
2. Retractable Landing Light - in the forward lower surface of each wing between the inboard and outboard nacelles.
3. Recognition Lights - Customer furnished - one on the top, and one in the bottom of the fuselage.

3a. Recognition Light Switch - A Customer furnished key and switch shall be located left of the pilots' pedestal, and near the instrument panel.

4. Head Light - in the front gunner-bomb aimer compartment.
5. Formation Lights - Three on the fuselage top and four on the upper side of the stabilizer. (Identical to U.S. Army installation).

135. Interior lighting shall be provided to illuminate the crew stations, equipment, and passageways. The pilots' instruments shall be illuminated by ultra-violet ray projectors. The compass, and automatic pilot, shall be equipped with individual integral lights.

(B) 135a. A directional light system is unnecessary with the Sperry O-1 bombsight.

(B) 135b. An intercall light shall be located at each of the following stations:

1. Upper mid-turret - Light to be furnished with the turret. Wiring will be provided.
2. Tail Turret - Light to be furnished with the turret. Wiring will be provided.
3. One waist gun station.
4. W/T operator.
5. Front gunner - bomb aimer.

136. Metallic parts of the airplane not completely insulated from the balance of the structure shall be in close electrical contact with adjacent parts. Where the joint is such that the resistance between parts may vary considerably, a supplementary electrical bond shall be provided.

137. Electrical wiring in the generator circuit between the generator and its control box, and in the ignition circuit (both high and low voltage) shall be fully shielded. No other shielding shall be used.

138. Provisions for the installation of electric power outlets, at the aft crew stations, for electrically heated flying suits shall be installed.

139. Camera installation wiring shall be provided.

139a. Four ammeters and a voltmeter shall be located on, or near, the flight deck rear wall.

139b. A projector light mounted on a ball and socket joint shall be installed near the aft edge of the pilots' enclosure to illuminate the flight deck.

139c. Projector lights mounted on extension brackets shall be installed over the navigator's and radio operator's tables.

J - HYDRAULIC SYSTEM

140. An hydraulic system shall be provided to operate the wing flaps, alighting gear, wheel brakes, bomb doors, and automatic pilot.

141. The wing flaps, bomb doors, and the alighting gear operating mechanisms shall be connected to an hydraulic pump mounted on, and driven by the right inboard engine.

142. The wheel brakes shall be operated by two parallel acting hydraulic systems. Each system shall operate from its accumulator through an actuating valve to a pair of expander tubes at each brake. Both accumulators shall be operated by one electric motor driven hydraulic pump to maintain operating pressure. A de-booster shall be incorporated in each system to reduce actual wheel brake pressure. In addition to brake operation, one of the accumulators shall be connected to the engine-driven pump through an automatic valve which will open to supply brake pressure should the motor-driven pump be unable to maintain the normal operating pressure. The bomb doors will be operated from one of the accumulators when the utility control valve is utilized.

143. A hand-operated hydraulic pressure pump, for emergency use, shall be located to the right of the second pilot.

144. An hydraulic fluid reservoir, with an approximate 5.4 Imp. gallon capacity, shall be installed. Its normal outlet shall be located to provide an emergency fluid supply in the lower half of the reservoir.

145. The automatic pilot shall be operated by the principle hydraulic system.

K - VACUUM SYSTEM

150. A vacuum pump shall be installed on each of two engines on one side to supply power to the de-icer boots, suction operated instruments, and automatic pilot. An oil separator shall be provided with each pump and connected to return oil to the main crank case. A selector valve shall permit [illegible] arrangement.

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151. A vacuum selector valve control will be located on the flight deck rear wall.

L - ICE ELIMINATION EQUIPMENT

170. Ice elimination equipment consisting of de-icer boot installations on the wings, fins, and stabilizer shall be provided in addition to propeller anti-icer slinger rings, pumps, valves, separators, reservoirs and associated equipment. Operating controls shall be located near the second pilot. Metal wing and stabilizer fairing installations shall be provided for use when the de-icer boots have been removed.

171. Anti-icer and de-icer controls shall be located under the second pilot's instrument panel.

172. Interior anti-icing heating ducts, and an exterior anti-icing glycol spray installation shall be provided for the pilots' windshield, and the bomb aimer's window.

M - HEATING, VENTILATING, AND SOUNDPROOFING

180. A ventilating system to vent outside air, free of exhaust odors, through ducts to outlets in the front gunner-bomb aimer compartment and the pilots' compartment shall be provided.

181. A Stewart-Warner heating system incorporation six unit heaters shall be installed. Two of the heaters shall be in the front gunner-bomb-aimer's compartment, one on each side. The remaining heaters shall be on the flight deck. The fuel-air mixture to operate the W/T operator's, first pilot's, and bomb-aimer's (LH) heater units shall be obtained from the inboard left engine while the units of the W/T operator's, second pilot's, and bomb-aimer's (RH) shall obtain their fuel-air mixture from the right inboard engine. Exhaust gas from each group of unit heaters shall be piped back to its respective inboard engine.

182. The walls of the front gunner-bomb-aimer compartment and the pilots' compartment shall be treated for soundproofing and heat insulation.

N - FURNISHINGS (Refer to Appendix IV)

190. Stowage will be provided for:

DESERT EQUIPMENT, which includes normal rations, emergency ration and water bottles sufficient for all crew members.
2 MEDICAL KITS
3 PARACHUTES, for Waist Gunner, Under Defense Gunner and Tail Gunner. Additional stowage provisions for lap type parachutes shall accommodate one parachute in the front gunner-bomb aimer' compartment and four parachutes of the same type on the flight deck.

191. A navigator's table will be located behind the first pilot on the left of the fuselage, and shall be provided with mounting holes for the navigator's compass.

192. Two Customer furnished compass mounts shall be located in the front gunner-bomb aimer compartment on either side of the nose enclosure.

193. The following items shall be installed in each airplane:

3 pilots' safety belts, 3 gunners' safety belts, 2 windshield visers, a relief tube assembly, a pilot's map case, and a rear entrance ladder.

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194. Stowage shall be provided [illegible] navigation equipment, a navigator's pencil [illegible]

C - RADIO AND INTERPHONE

200. The radio table, seat, and other equipment will be located on the right side of the flight deck behind the second pilot. The radio compass loop will be situated on top of the fuselage aft of the pilots' enclosure.

201. Radio equipment shall consist of the following units:

1. Main, Bendix.
2. Command, British
3. Blind Approach, British
4. Radio Compass, Bendix
5. R-3003 Equipment, British
6. Interphone, British
7. Alternate Interphone, Bendix

202. Controls for the Customer furnished radio equipment listed below shall be provided at the following stations:

1. Blind Approach - First Pilot
2. Command - Second Pilot
3. Compass - Navigator
4. Interphone - One outlet will be located at each crew station.
5. Main Radio - W/T operator.
6. R-3003 - Accessible to W/T operator.

203. The Contractor shall provide and install the following Bendix Radio equipment in each airplane: Two Transmitters, TA-12C; One Receiver, RA-10; One Radio Compass, MN-26; One Interphone Model 3611. In addition, station boxes, controls, indicators, junction boxes, a mounting rack and other accessories shall be provided and installed.

204. The Contractor shall provide and install a Bendix, Type 1722 B, filter in the engine-driven generator circuit of each airplane.

205. Installation provisions for the following British radio equipment shall be made in each airplane: TR-9F, A-1134, R-3003, R-1124A, R-1125A, and accessories.

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P - OXYGEN EQUIPMENT

210. Twelve oxygen bottles will be located in the front gunner-bomb aimer compartment, and 12 additional bottles will be located aft of the wing. One oxygen outlet will be provided at each of the following stations: Front Gunner-Bomb Aimer, First Pilot, Second Pilot, Navigator, W/T Operator, Upper Mid-Turret Gunner, Waist Gunners, Under Defense Gunner, and Tail Gunner. All related parts except the necessary tubing shall be Customer furnished.

211. Installation provisions for a Customer furnished oxygen flowmeter in the mid-turret and the tail turret shall be made in accordance with C.A.C. Drawings 32F5242 (mid-turret), and 32F5240 (tail turret).

Q - PHOTOGRAPHIC EQUIPMENT

220. Provision shall be made for the installation of a Customer furnished Type F-24 photographic equipment in the fuselage bottom aft of the bomb bay. One opening shall be provided for taking vertical photographs with electrical control to the bomber, and another opening, to the left of the fuselage center, shall be provided for oblique photographs with electrical control to the pilot. An oblique camera sight shall be provided at the first pilot's side window. The camera and removable associated equipment shall be considered part of the alternate load.

221. A Fairchild direct vision view finder, with a post type mount shall be provided and installed on the exterior, left side, of the pilots' compartment.

222. An electrical socket shall be installed in the vicinity of the camera to connect a Customer camera heater muff.

R - ARMAMENT

230. The ordnance installation shall consist of the following:

Provisions for: a Sperry O-1 bombsight, a front .303 calibre machine gun, a Customer furnished tail turret, a Customer furnished upper gun turret aft of the wing rear spar, and the carrying and releasing of bombs.
A waist gun station on each fuselage side with provisions for twin .303 calibre machine gun installations. (Customer furnished).
An under defense gun station with provision for one .303 calibre machine gun.
Protective armor for the crew as described in Paragraphs 237 and 238.

231. Provision shall be made for the installation of a Customer-Furnished Sperry O-1 bombsight in the nose enclosure. A bomb-aimer's seat, designed for fore and aft movement, shall be provided and installed to facilitate bombsight operation. Vertical adjustment shall be possible only when the airplane is on the ground.

232. Provision shall be made to carry such British bombs as can be carried within the bomb bays and in the racks furnished in U.S. Army airplanes of this type. The following items will be furnished to facilitate installation of British bombs:

1. Special shackles in accordance with C.A.C. Drawing 32R199.
2. Special wiring required for Type B fusing units, and British electrical bomb release unit.
3. Rubbing strips on rack hangars to prevent interference between falling bombs and the special shackles

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232a. Should the bombs carried be similar in shape to U.S. Army bombs of the same weight classification, the following loads may be carried:

4 - 2000 lb. demolition bombs, or
8 - 1100 lb. demolition bombs, or
10 - 600 lb. demolition bombs, or
12 - 300 lb. demolition bombs, or
20 - 100 lb. demolition bombs.

(a) According to present available information, it should be possible to carry the following British bombs:

1. 4 - 2000 lb. U.S. Type
2. 4 - 1000 G.P., and 2 - 500 G.P. (or S.A.P.) Rear Bay plus
   4 - 500 G.P., and 2 - 500 S.A.P., or,
   6 - 500 S.A.P. - Front Bay
3. 12 - 500 (10 G.P. + 2 S.A.P.), or (12 S.A.P.)
4. 12 - 250
5. 4 - Small Bomb Container

B)(b) The bomb supporting equipment shall consist of removable shackles mounted on permanently installed racks. Exceptions to the above installation will be those for the 2000 lb. bombs which will have shackles mounted on a special brace structure. It should be noted that when 10 - 600 lb. bombs are carried there will be reduced clearance between the two lower bombs in the forward bay and the doors when closed.

(c) The bomb release equipment shall be electrically operated and controlled by the bomb aimer. Release equipment shall allow selective or train salvo release in either the armed or safe condition.

B)(d) A manually operated emergency salvo release, operable from both the front gunner-bomb aimer compartment, and the pilots' compartment, shall be provided.

(e) The electrical release system for the 2000 pound bomb stations shall also be utilized to release bombs from the British type small bomb container.

B)(f) It will be impossible to electrically or manually release any bombs unless the bomb doors are opened. Hydraulic door actuating controls shall be provided for the front gunner-bomb aimer, and shall also be interconnected with the pilots' salvo release. Mechanical door operating provisions shall be installed. To open the bomb doors when the airplane is on the ground, an exterior control shall be installed in the fuselage right forward side.

(g) Manual bomb release shall be possible by tripping the bomb bay shackles from within the bomb bays.

B)(h) The bomb interval control shall be of the U.S. Army type, or equivalent approved type.

B)233. Provision for the flexible gun in the lower nose shall consist of a ball and socket mount with a snap lock adapter for a Browning-Colt .303 calibre machine gun and magazines for 500 rounds of ammunition.

B)234. **Structural provision shall be made in the fuselage top, immediately aft of the wing, for Customer installation of a power operated gun turret that shall weigh 630 pounds and have a turret ring 43 inches in diameter. The turret shall be bolted to a Contractor installed supporting ring which shall have an outside diameter of 45.5 inches**

235. Installation provisions shall be made for Customer furnished and installed twin Browning-Colt .303 calibre machine guns in each side of the fuselage at the waist gunners' stations.

235a. Provision for a .303 calibre Browning-Colt machine gun in the rear bottom entrance door shall consist of a ball and socket mount with a snap lock adapter. Provisions shall also be made for 500 rounds of ammunition.

236. Structural provision shall be made for Customer installation of a Customer furnished power operated tail turret. A temporary closure completing the normal stern fuselage lines shall be provided for use prior to the turret installation. No provision shall be made for ammunition boxes or ammunition track.

237. Armor plate, approximately 6 mm. thick, shall be provided behind the seats of the bomb aimer, and the first and second pilots' from the top of their heads to approximately the center of their seat backs. Ten (10) mm. armor plating shall be provided the navigator and W/T operator, but shall extend from the top of their heads to the bottom of their seats. All armor plate installations shall be limited to a total weight of 1000 pounds.

238. One section of armor plate, with a thickness of approximately 6 mm., and an area of approximately 6 sq. ft., will be provided just aft of each waist gunner's station.

239. Oxygen bottles shall be protected within a 20° cone from rear fire by armor plate of approximately 6 mm. thickness. The group of bottles shall be surrounded by a 1/16" aluminum alloy plate to act as a guard against bottle fragments, should any bottles explode.

S - PYROTECHNICS

240. A Customer furnished Very's pistol mounting sleeve, Mk. I, shall be mounted in the fuselage top over the navigator's table. Stowage provisions shall be made for 8 Signal Cartridges and 4 Smoke Puffs shall be stowed on flight deck.

241. A U.S. Army type flare rack, and a 4.5 flare chute shall be installed aft of the bomb bay. The rack release handle shall be located left of the first pilot. Stowage provisions for 10 Reconnaissance Flares shall be installed aft of the wing. The top of the flare chute shall slope forward 30° from the vertical. For Customer furnished pyrotechnic items, refer to Page 35.

242. Stowage shall be provided for the following Customer furnished and installed pyrotechnic equipment: 12 Flame Floats or Sea Markers, 3 Distress Signals, and 2 Landing Flares.

T - SPECIAL EQUIPMENT

250. The following equipment will be furnished in the quantities specified for use with this airplane:

Quantities	Items	Drawing Numbers
1 per 1 Airplane	Airplane Hoisting Sling	32H011
1 per 1 Airplane	Nose Wheel Towing Bar	32U004
1 per 1 Airplane	Special Tool Kit-Airplane	32U010
1 per 6 Airplanes	Spreader Bar and Hook Sling for Engine	BY 28H5055
1 set per 1 Airplane	Engine Covers	32F164

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U - FIRE EXTINGUISHERS

260. Engine fire extinguisher controls will be located to the right of the co-pilot's seat.

261. One hand portable fire extinguisher will be located on the flight deck, and another will be located in the aft section of the fuselage.

262. One forward, and one aft, hand pyrene fire extinguishers will be located in the fuselage side. Both extinguishers shall be accessible from the exterior.

LIST OF APPENDICES

I. Three-View Drawing 32-Z-5006

II. Inboard Profile Drawing 32-Z-5005

III. Finish Specification ZF-32-006

yes IV. List of Contractor Furnished Equipment

yes V. List of Customer Furnished Equipment

yes VI. Diagram-Overall Dimensions of Main Components

APPENDIX IV

LIST OF CONTRACTOR FURNISHED EQUIPMENT

The following listed items shall be furnished by the Contractor in accordance with contract terms. Listed quantities are required for one airplane. The contractor reserves the right to make substitutions of equal standard for any listed item.

Quantity	Item	Manufacturer	Part Number
	ARMAMENT		
1	BOMB INTERVAL CONTROL	P.R.Mallory Co.	B-2
1 pr.	HOIST, Bomb, Type C-3	Taylor Machine Co.	36H5311
12	SHACKLES, Bomb	Columbis Aircraft Industry	32R199, L & R
	ELECTRICAL		
4	AMMETER, Scale 20-0-100	Weston	606
2	BATTERY DISCONNECT SWITCH	Eclipse	C7311110-2
2	BATTERY, Storage (24-volt)	Exide, type 75-9D	DD24842
4	BOOSTER COIL	Star Mach.Co.	2525
1	DYNAMOTOR (Autosyn Power Sup.)	Pioneer	10043-2
1	HEAD LIGHT INSTALLATION	C.A.C.	32E5109
2	IGNITION SWITCH, Dual, Type B-4	Scintilla	10-9483-1
2	INSTRUMENT LIGHTS, Spars	Kollsman	3V
1	INVERTER, Flourescent Lighting	Electronic Lab.	S-665
3	LAMP HOLDER, with Ultra violet lamps	Electronic Lab.	X205
1	LANDING GEAR WARNING HORN	Delco-Remy	199971
2	LANDING LIGHT, with bulb Type B-1	Grimes	ST1220
6	NAVIGATION LIGHT	Gem City	Type A8
2	PRIMER SWITCHES, Dual	Cutler-Hammer	AN3019
3	PROJECTOR LIGHT	Fostoria	M Type Shade & #112 lt.
2	PUSH BUTTON SWITCH	Anthony Machine Works	SOS
4	STARTER SWITCH	Eclipse	C66198
1	VOLTMETER, 30-v	Weston	92464
7	LIGHT, Formation, Blue	Gem City	Type A8
1	SWITCH	Cutler-Hammer	AN3014
8	SWITCHES	Cutler-Hammer	AN3015
1	SWITCH	Cutler-Hammer	AN3016
2	SWITCHES	Cutler-Hammer	AN3017
2	SWITCHES	Cutler-Hammer	AN3018
10	SWITCHES	Cutler-Hammer	AN3019

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APPENDIX IV, (Continued)

(C) HYDRAULICS

Quantity	Item	Manufacturer	Part Number
2	ACCUMULATORS, 10"	Aircraft Access.	14005
2	ACTUATING CYLINDER, Bomb Door	Aircraft Access.	22028B
2	ACTUATING CYLINDER, Main Landing Gear	Aircraft Access.	2026B-2
1	ACTUATING CYLINDER, Nose Wheel	Aircraft Access.	22029B-2
1	ACTUATING CYLINDER, Wing Flap	U.A.P.	51381
1	SELECTOR VALVE, Bomb Door	Interstate	0103-B
1	SELECTOR VALVE, Ldg. Gear	Interstate	0103-L
1	SELECTOR VALVE, Wing Flap	Interstate	0103-F
1	FOUR WAY VALVE, Bomb Door	Adel	B-9588
1	CHECK VALVE	Parker	8AGVET-CHK
2	CHECK VALVE	Parker	475-HT-10D
2	CHECK VALVE	Parker	475-HT-8D
1	CUNO FILTER		11280
4	DE-BOOSTER CYLINDER	Aircraft Access.	36019
1	EMERGENCY UNLOADING VALVE	Aircraft Access.	55011
1	ENGINE DRIVEN PUMP	Vickers	PF2-713-25BC
1	FLOW DIVIDER	Pesco	397
1	HAND HYDRAULIC PRESSURE PUMP	Pesco	437-C
1	HYDRAULIC GAGE (0-300 lb/sq.in.)	Kollsman	131F
3	RELIEF VALVE	Pesco	436
1	RETURN VALVE	Adel	B8045
2	SHIMMY DAMPER (Nose Wheel)	Aircraft Access.	24001-1
1	SHUTTLE VALVE	Pesco	CAC 32R187 Mo
1	UNLOADING VALVE	Vickers	14506

(C) (D) INSTRUMENTS AND THEIR OPERATING EQUIPMENT

1	AUTOMATIC PILOT, Parts are per Sperry Dwg. #614264-E, Ref.	Sperry	Model A-3
3	AIRSPEED INDICATORS	Kollsman	586S-024
2	AIRSPEED TUBE	Kollsman	369D-02
3	ALTIMETER	Kollsman	371S-03
1	ANTI-ICING FLUID GAGE	Boston Gage Co.	SK-106-111
2	CLOCKS	Pioneer	3310-2
1	COMPASS, Aperiodic	Pioneer	1809
2	CYLINDER TEMPERATURE INDICATORS, Dual	Lewis Engr.Co.	96AT7
2	FUEL PRESSURE INDICATORS, Dual Autosyn	Pioneer	6007
4	FUEL PRESSURE TRANSMITTERS, Autosyn	Pioneer	4050
1	GYRO, DIRECTIONAL	Sperry	643715
1	GYRO, HORIZON, without Caging Knob	Sperry	643710
3	HYDRAULIC PRESSURE INDICATORS	Pioneer	240Z-6A
1	INCLINOMETER, for fuel sight gage	Pioneer	651-B
1	LANDING GEAR & WING FLAP POSITION INDICATOR	General Electric	8DJ-4PXC
3	LANDING GEAR POSITION TRANSMITTERS	General Electric	8TJ-9PXE
1	FLAP POSITION TRANSMITTER	General Electric	8TJ-9PAB

APPENDIX IV, (Continued)

LIST OF CONTRACTOR FURNISHED EQUIPMENT (Continued)

Quantity	Item	Manufacturer	Part Number
c)	INSTRUMENTS & THEIR OPERATING EQUIPMENT (Cont'd.)		
2	MANIFOLD PRESSURE INDICATORS, Dual Autosyn	Pioneer	6007
4	MANIFOLD PRESSURE TRANSMITTERS, Autosyn	Pioneer	4250
2	OIL PRESSURE INDICATORS, Dual Autosyn	Pioneer	6007
4	OIL PRESSURE TRANSMITTERS, Autosyn	Pioneer	4150
2	OIL SEPARATORS (Vacuum)	Pesco	218T
2	OIL TEMPERATURE INDICATORS, Dual Electric	Lewis	97AT3
4	OIL TEMPERATURE BULBS, Electric (For Above)	Lewis	67-B Special
1	RATE OF CLIMB INDICATOR	Kollsman	366B-03
2	TACHOMETER INDICATORS, Dual Autosyn	Pioneer	6007-28B6) 1 e 6007-28A1)
4	TACHOMETER TRANSMITTERS, Autosyn	Pioneer	4350-2A
4	THERMOCOUPLE, GASKET TYPE	Lewis Engr.Co.	8T-30
2	THERMOCOUPLE LEADS, 8 Ohm, with 6 ft. engine section	Lewis Engr.Co.	L65A-40
2	THERMOCOUPLE LEAD, 8 Ohm, with 6 ft. engine section	Lewis Engr.Co.	L65A-60
1	THERMOMETER, FREE AIR, with Bulb	Weston, Type 2CL	Model 728
1	TURN AND BANK INDICATOR	Pioneer	1707-2A-A2
c)	LANDING GEAR		
2	BRAKE VALVES	AAC	36002
1	STRUT, NOSE WHEEL	Bendix	54206
2	STRUT, MAIN WHEEL	Bendix	54205
2	TIRE, MAIN WHEEL, 56"dia. 16-Ply	Goodrich	AC26545
1	TIRE, NOSE WHEEL, 36"dia. 10-Ply	Goodrich	AC26545
2	TUBE, MAIN TIRE, 56" dia. Type I	Goodrich	AC26546
1	TUBE, NOSE TIRE, 36" dia. SCB	Goodrich	AC26563
2	WHEEL, MAIN 56" dia., Type II	Hayes Indust.	AC25258
1	WHEEL, NOSE, 36" Dia.	Hayes Indust.	H-3-102
1	WHEEL, TAIL, 4-Ply	Hayes Indust.	28H1058
c)	POWER PLANT - FUEL & OIL		
4	BOOSTER PUMP	Thompson	TED-6300
4	FUEL PUMP	Thompson	G-6
1	FUEL TRANSFER PUMP	Clark Aero-Hydra.	A04
2	MOTOR DRIVEN PUMP (Anti-Icer) with 450-20 base	Pesco	453A
4	OIL COOLERS, 12" diameter	United Aircraft	U-3430-F5

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APPENDIX IV (Continued)

LIST OF CONTRACTOR FURNISHED EQUIPMENT (Continued)

Quantity	Item	Manufacturer	Part Number
	POWER PLANT - FUEL & OIL (Continued)		
1	OIL SEPARATOR (De-Icer)	Eclipse	3356-1
5	OIL TANK CAPS		AC0153682
4	STRAINERS	United Air.Pr.	U-650C
2	VACUUM PUMP	Pesco	211J
4	"Y" OIL DRAIN VALVE	United Air.Pr.	U-1050-B3
	MISCELLANEOUS		
2	ANEMOSTAT (Ventilating)	Anemostat Corp.	5-CM
3	BONDING JACK (GROUND REFUELING)	Mallory Co.	B111745
1	CONTAINER, Drinking Water, 1.7 Gal.	B.E.H.& Co.	9-1/2" dia. x 17 LG
5	CUSHIONS, Seat Bottoms	C.A.C.	32F2032
5	CUSHIONS, Seat Backs	C.A.C.	32F2031
1 set	DE-ICER BOOTS	Goodrich	
1	DE-ICER DISTRIBUTING VALVE	Eclipse	3530-1
1	DE-ICER CONTROL VALVE	Eclipse	3529
1	FIRE EXTINGUISHER, Fixed CO_2 multi-engine, including 2 bottles #19743 and 1 panel	Kidde	7-1/2# Type
2	FIRE EXTINGUISHER, Hand, Pistol Grip	Kidde	85-2
2	FIRE EXTINGUISHER, Hand, Portable CO_2	Kidde	A-14
1	FLARE RACK, Type A-4	Pollack Mfg.	AC37-G-3628
1	FLARE CHUTE, for 4.5 flare	C.A.C.	32F3589
6	HEATING SYSTEM RADIATOR UNITS	Stewart-Warner	789-F(4e): 789-G(2e)
1	LADDER, Entrance	C.A.C.	32F3302
1	LANDING GEAR WARNING HORN (PILOTS')	Delco	Type E-1
2	LIFE RAFT, 1000 Lb. Capacity	Air Supply	A-2
1	MAP CASE, Pilot's	C.A.C.	32F5076
1	PAD, Front Gunner-Bomb Aimer, Prone	C.A.C.	32F3594
2	PILOTS' ENCLOSURE SIDE WINDOW DOMES	C.A.C.	32D1005
2	RELIEF TUBE	United Air.Pr.	AC33A4739
2	RELIEF TUBE BRACKET	United Air.Pr.	AC33B4741
3	SAFETY BELTS, Gunner, Type A-3	Switlik	AC30-1334
3	SAFETY BELTS, Pilot, Type B-11	Switlik	AC34C1646
1	SEAT, Front Gunner-Bomb Aimer, with Parachute Provisions	C.A.C.	32F2030-3
2	SEATS, Pilots', with Parachute Provisions	C.A.C.	32F2010-L&R
2	SEATS, W/T Operator & Navigator, with Parachute Provision	C.A.C.	(32F2030-50(W/T (32F2030-2 (Na
1	TABLE, Navigator	Cal.P.& V.Co.	32F5081-6 & -
1	TOILET, Dry Type	Sierra San.Co.	CC390829
2	VISOR, 6 x 12-3/4	Sol'Auto Sup.	550
2	VALVE, Check & Pressure Relief	Weatherhead	2751900
1	VALVE, Suction Regulator	Eclipse	M-2860-C3
2	[illegible]	Pesco	216-B
1	[illegible]	[illegible]	32F3583

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APPENDIX IV (Continued)

(C) LIST OF CONTRACTOR FURNISHED EQUIPMENT (Continued)

Quantity	Item	Part Number
	(C) (D) BENDIX (MAIN RADIO) EQUIPMENT	
2	TRANSMITTERS (Complete with mounting bases, connecting plugs, tubes, and connecting cables)	TA-12-C
1	TELEGRAPH KEY	MT-11 B
1	CONTROL UNIT (Transmitter)	3616 B
1	POWER SUPPLY & MODULATOR UNIT (Complete with tubes and mounts)	MP-28-B
2	ANTENNA LOADING UNIT	MT-53 B
1	RECEIVER (Complete with tubes and shock mount)	RA-10-DA
1	REMOTE CONTROL UNIT	MR-9-B
1	MECHANICAL TUNING SHAFT	AA15410-1
1	EQUIPMENT MOUNTING RACK	32F5210
1	CONTROL UNIT MOUNTING RACK	32F5311
1	TRANSFER UNIT (Built into 3509 junction box)	BX52-6, Model 392
4	FILTERS	1722 B
1	VACUUM ANTENNA SWITCH	3926A
1	JUNCTION BOX	3509
	(C) (D) BENDIX MN-26 RADIO COMPASS EQUIPMENT	
1	COMPASS RECEIVER (Complete with tubes & shock mts.)	MN-26C
1	REMOTE CONTROL UNIT	MN-28C
1	AZIMUTH INDICATOR	MN-22A
1	CRANK ASSEMBLY	MR-15A
1	LOOP ANTENNA	MN-24A
1	TRANSMISSION CABLE	AC-55966-1
1	TUNING SHAFT, LOOP TO MN-22A	AA-15410-1
1	TUNING SHAFT, MN-26 TO MN-28	AA-15410-1
1	COUPLING, MN-22 TO MR-15	3952
2	RIGHT - LEFT INDICATOR	IN-4A
1	JUNCTION BOX	3506 A
1	AUDIO, SELECTOR SWITCH	3726
1	SET CABLES, PLUGS, TUBES AND MOUNTING BASES	
	(C) (D) BENDIX INTERPHONE EQUIPMENT	
1	INTERPHONE AMPLIFIER	3611
10	INTERPHONE STATION BOX	3620
3	JUNCTION BOXES	3510
1 Set	ELECTRICAL CABLES (Including wire, flexible conduit and fittings)	
	(C) (D) ANTENNA	
1	ANTENNA REEL, (With 200' wire and weight)	MT-5E
1	ANTENNA CHANGE OVER & GROUNDING UNIT	3939
2	STRAIN INSULATORS	MT-48 A
5	STRAIN INSULATORS	NAF38787-2
1	SENSE ANTENNA WIRING & HOOK-UP	
1	LEAD-OUT INSULATOR	NAF37016
1	TRAIL[illegible]	32F5120

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(C) (D) APPENDIX V

LIST OF CUSTOMER FURNISHED EQUIPMENT

The following listed items shall be furnished by the Customer in accordance with contract terms. The quantities listed are required for one airplane.

Key - * Customer furnished. Installed by Contractor
** Customer furnished and Customer installed.

Quantity	Item	Manufacturer	Part Number
**	AMMUNITION AND BOMBS		
* 1	BOMBSIGHT	Sperry	0-1-24
** 24	FUSING UNITS		5D/606
** 2	MACHINE GUNS, .303 caliber (Not including Turret Guns)	Browning-Colt	A-88-A
** 1	MID-TURRET (Complete with Guns)	Boulton-Paul	D-198A
** 1	TAIL-TURRET (Complete with Guns)	Boulton-Paul	D-440E
** 2	BEAM DEFENSE GUN MOUNT (complete with guns)		E-138501A
	ELECTRICAL		
* 4	GENERATOR, 1 1/2 KW	Eclipse	314
** 1	LAMP, ALDIS		
* 1	LAMP, IDENTIFICATION, Upward	S.I.S.1583	Type C
* 1	LAMP, IDENTIFICATION, Downward	S.I.S.1925	Type C
* 4	REGULATOR, VOLTAGE	Eclipse	337
* 1	SWITCH BOX IDENTIFICATION	S.I.S.1521	Mk.III,#2
* 1	SOCKET, Outside Battery Plug-In		5C/589
	EQUIPMENT		
** 1	CAMERA, Photographic		F-24
** 1	CAMERA HEATER MUFF		
* 1	COMPASS, Aperiodic		0-2
* 1	NAVIGATOR'S OBSERVATION DOME		
	OXYGEN EQUIPMENT		S.I.S. 2601
		S.I.S.No. / Item No.	
* 24	CYLINDER, GAS (Oxygen Mk.V Complete with 3-way piece Mk.V)(including Mk.I nonreturn valve - S.I.S. 2601 Item #9 Ref. No. 6D/427)	576 / 1 Sheet #2	
* 2	REGULATOR, OXYGEN Mk. X	2604	2
* 4	MANIFOLD, OXYGEN, Mk. I	2602	3
* 10	INDICATOR, Flow Mk. II (Connections at sides)	2603	4
* 10	SOCKET, Bayonet Union Mk. IIIB	590	7 6D/112
* 2	FLOWMETER, OXYGEN	2603	

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(C) APPENDIX V (Continued)

LIST OF CUSTOMER FURNISHED EQUIPMENT (Continued)

OXYGEN EQUIPMENT (Continued)

Quantity	Item	Manufacturer S.I.S. 2601 S.I.S. No.	Item No.	Part Number
*1	VALVE, H.P. Oxygen, Mk. VIII	598	8	6D/223
	This Item Included in Item #1		9	6D/427
*6	CAP, BLANKING		12	
*2	PIECE, CONNECTING, 3-Way		13	
*30	UNION (LOW PRESSURE) Mk. I (Str. Body)	501	14	28/5104
*70	UNION (LOW PRESSURE) Mk. I (Nut)	501	17	28/5108
*70	UNION (LOW PRESSURE) Mk. I (Bushing)	501	18	28/5109
*5	PIECE, CONNECTING, 2-Way, Mk. III	580	19	6D/116
*125	NIPPLE SPHERICAL, Mk. III	580	20	6D/39
*125	NUT, UNION, Mk. III	580	21	6D/40
*60	NIPPLE, SPHERICAL, Mk. IV		22	6D/240
*60	NUT, UNION Mk. IV		23	6D/241
*25	PIECE, CONNECTING, 3-Way Mk. III	580	24	6D/70
*2	PIECE, CONNECTING, 3-Way Mk. IV	597	26	6D/122
*10	PIECE, CONNECTING, 4-Way Mk. IV	597	27	6D/123
*20	METAL COUPLINGS - PIPE COLLAR, A.G.S. 902B		29	28/5698
*5	METAL COUPLINGS-NIPPLES A.G.S. 903B		30	28/5704
*20	METAL COUPLINGS-OUTER SLEEVE A.G.S. 904B		31	28/5722
*5	METAL COUPLINGS-INNER SLEEVE A.G.S. 905B		32	28/5716
*15	METAL COUPLINGS-ADAPTOR NIPPLE A.G.S. 906B		33	28/5701

RADIO EQUIPMENT

BRITISH R-3003 EQUIPMENT

**1	RECEIVER & MOUNTING	S.I.S. 1382
**1	CONTROL UNIT (Receiver)	S.I.S. 1384
**1	SWITCH	S.I.S. 1372

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(C) APPENDIX V. (Continued)

LIST OF CUSTOMER FURNISHED EQUIPMENT (Continued)

BRITISH TR-9F COMMAND EQUIPMENT

Quantity	Item	Manufacturer	Part Number
**1	TRANSMITTER & RECEIVER		S.I.S. 1291
**1	REMOTE CONTROLLER		S.I.S. 1028
**1	ACCUMULATOR		S.I.S. 1916
**1	AMPLIFIER, Type A-1134		S.I.S. 1345
	BRITISH BLIND APPROACH EQUIPMENT		
**1	RECEIVER		Type R-1124A
**1	RECEIVER		Type R-1125A
**1	POWER UNIT		S.I.S. 1351
**1	VISUAL INDICATOR		S.I.S. 1352
**1	BLIND APPROACH AERIAL		S.I.S. 1354
**1	BLIND APPROACH AERIAL		S.I.S. 1355
**1	REMOTE CONTROL		S.I.S. 1356
**1	CONTROL UNIT		S.I.S. 1350
**1	JUNCTION BOX		S.I.S. 1353
**1	JUNCTION BOX (TEL. MIXING)		S.I.S.
	POWER PLANT		
*4	ENGINES, 14 Cylinder, Geared 16:9 With Accessories listed in P & W Specification 5083 which includes accessory drives for the Fuel Pump, Generator, Hydraulic Pump, Propeller Governor, Starter, Tachometer, and the Vacuum Pump	Pratt & Whitney	R-1830 S3C4-G
	AUTOMATIC MIXTURE CARBURETOR		PD-12F2
	AUTOMATIC VALVE GEAR LUBRICATION		
	DUAL SHIELDED IGNITION SYSTEM		
	OIL CONNECTION FLANGES (Plain Type) as furnished on R-1830-33 engines	Pratt & Whitney	
	SCAVENGING PUMP		Type C-5
*4 Sets	PEDESTAL MOUNT, DYNAMIC		
*4	PROPELLER, ELECTRIC, 11' 6" Dia. with BLADES, Three	Curtiss	89303-18
	CONSTANT SPEED GOVERNOR		100005-2
	FULL FEATHERING CONTROLS		
	HUB with SLINGER RING		C532D-F
*4	STARTER, Electric Inertia, Hand	Eclipse	429-14
*2	STARTER CRANK (To be reworked into one crank by C.A.C.)		
*4	STARTER MESHING SOLENOID		

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(C) (D) APPENDIX V (Continued)

LIST OF CUSTOMER FURNISHED EQUIPMENT (Continued)

PYROTECHNICS

Quantity	Item	Manufacturer	Part Number
*1	MOUNTING SLEEVE, Very's Gun		Mk. I
*12	FLAME FLOATS		12D/163
	OR		
*12	SEA MARKERS, ALUMINUM		12D/199
*10	FLARES, AIRCRAFT RECONNAISSANCE Mk. II, 4.5"		12D/187
*2	FLARES Forced Landing, U. S. Army Type		M - 8
*6	SIGNALS, DISTRESS MARINE		12D/181
*1	PISTON, SIGNAL NO. 3 Mk. II		7B/708
*1	DISC APERATURE		7B/710
*8	CARTRIDGE SIGNAL PISTOL 1-1/2"		S.I.S. 2117
*4	PUFFS, SMOKE 5.9" long x 1.68" diameter		S.I.S. 2117

MISCELLANEOUS

*2	HARNESS	Sutton
*1	PLOTTER	Vard
**8	HEADSETS & OXYGEN MASKS	

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APPENDIX VI

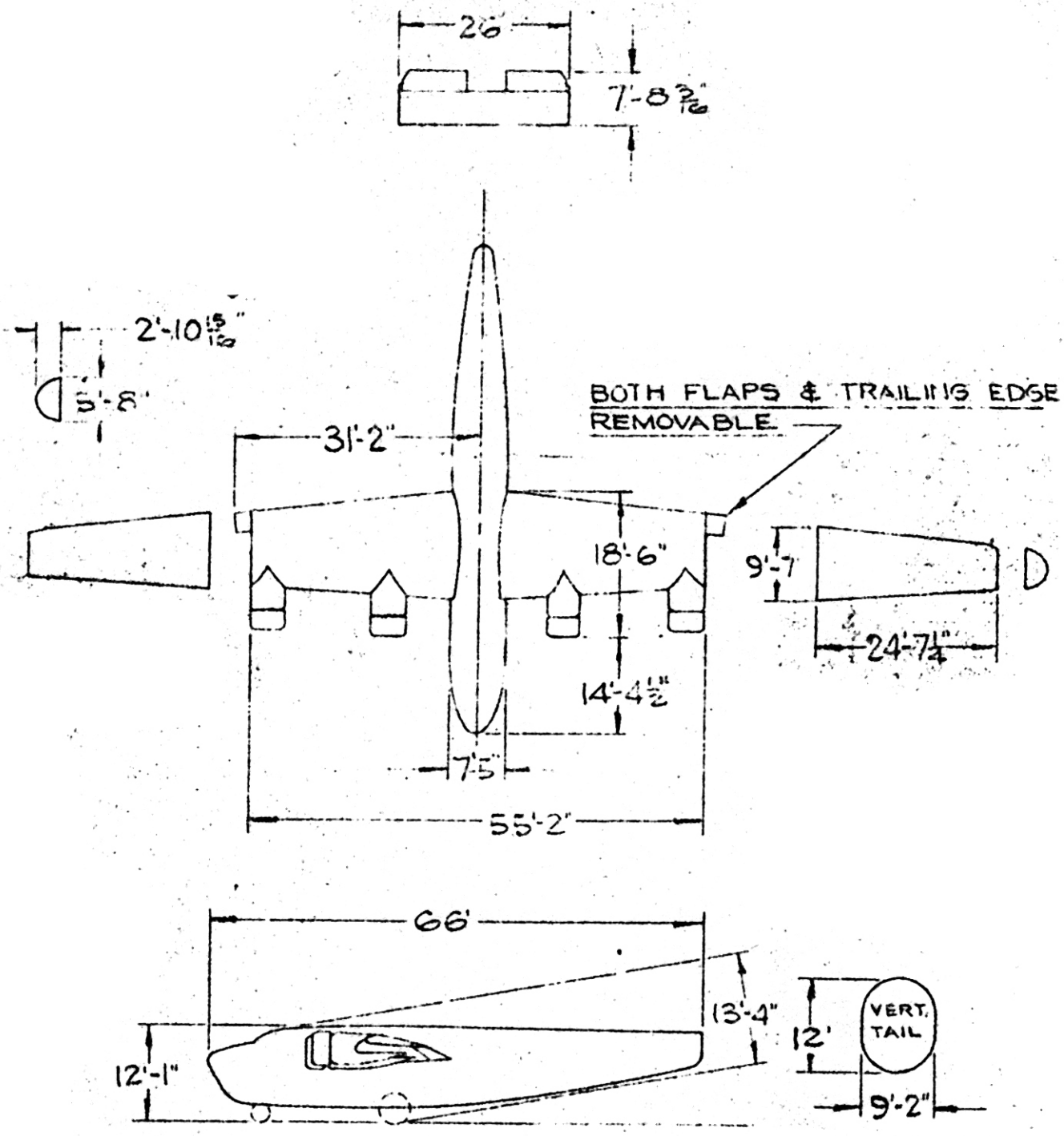

DIAGRAM - OVERALL DIMENSIONS OF MAIN COMPONENTS